

MDC Technology Real Time Optimization - RTO+

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Agenda

- Introduction to MDC Technology Division
- What is Process Optimization?
- Project Overview
 - MDC Project Execution
- Energy Optimization Example
 - DOW Chemicals (Freeport, TX) RTO System

MDC Technology Division



MDC Technology helps companies specify, design, implement and maintain advanced real time optimization and performance monitoring systems, that provide sustained value and measurable financial improvements in production.

And we do it fast and economically.

Products

→ MDC Technology Core Products:

— RTO+ - Real Time Optimization

- RTO+ is a complex rigorous model based system that resides above the DCS/SCADA level, and optimizes plant operations.

— *-fficiency* - Performance Monitoring

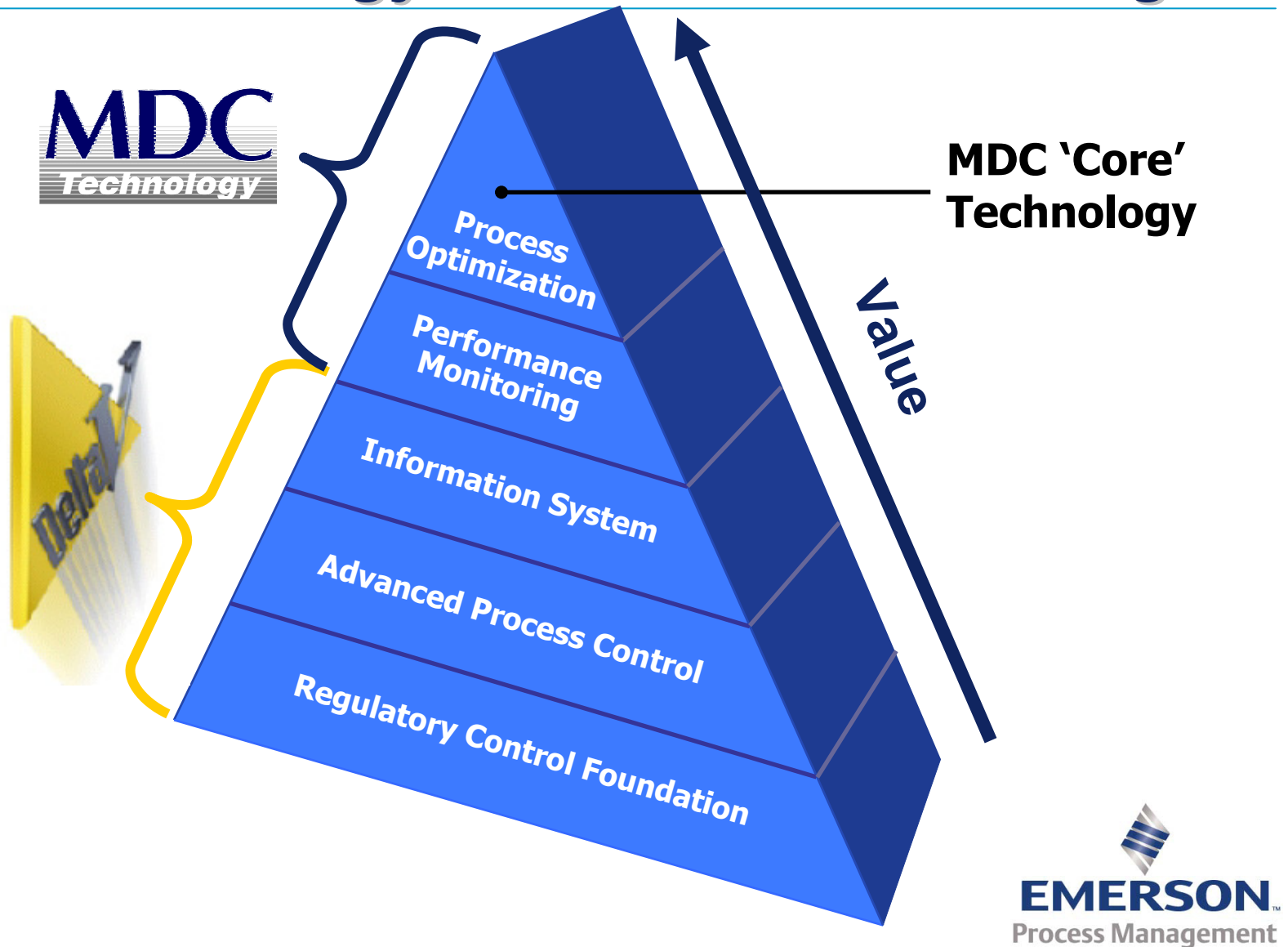
- *e-efficiency* is a web based system that accurately displays the performance of critical pieces of equipment.

MDC Technology



RTU+ - Real Time Optimization

MDC Technology - Product Positioning



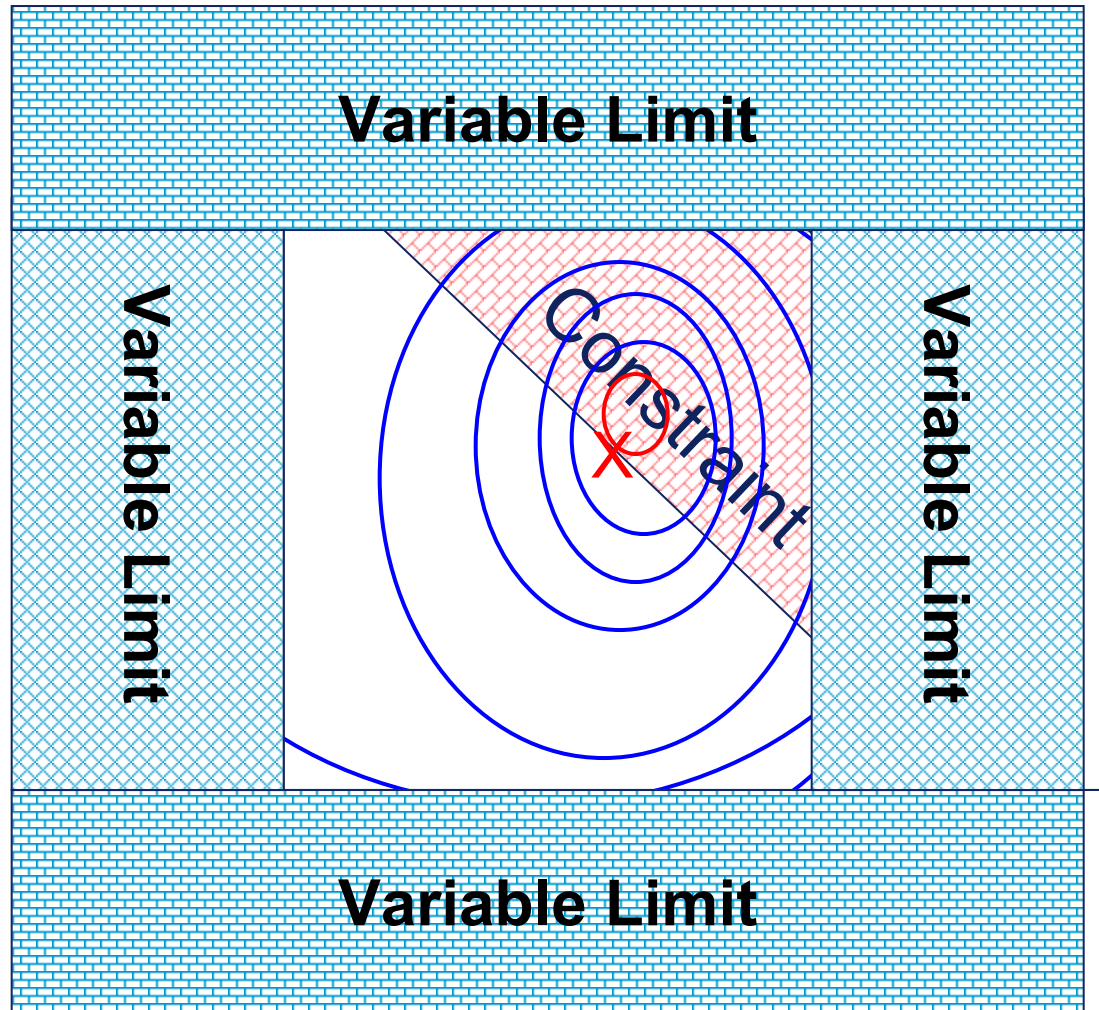
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RTO+ - Real Time Optimization

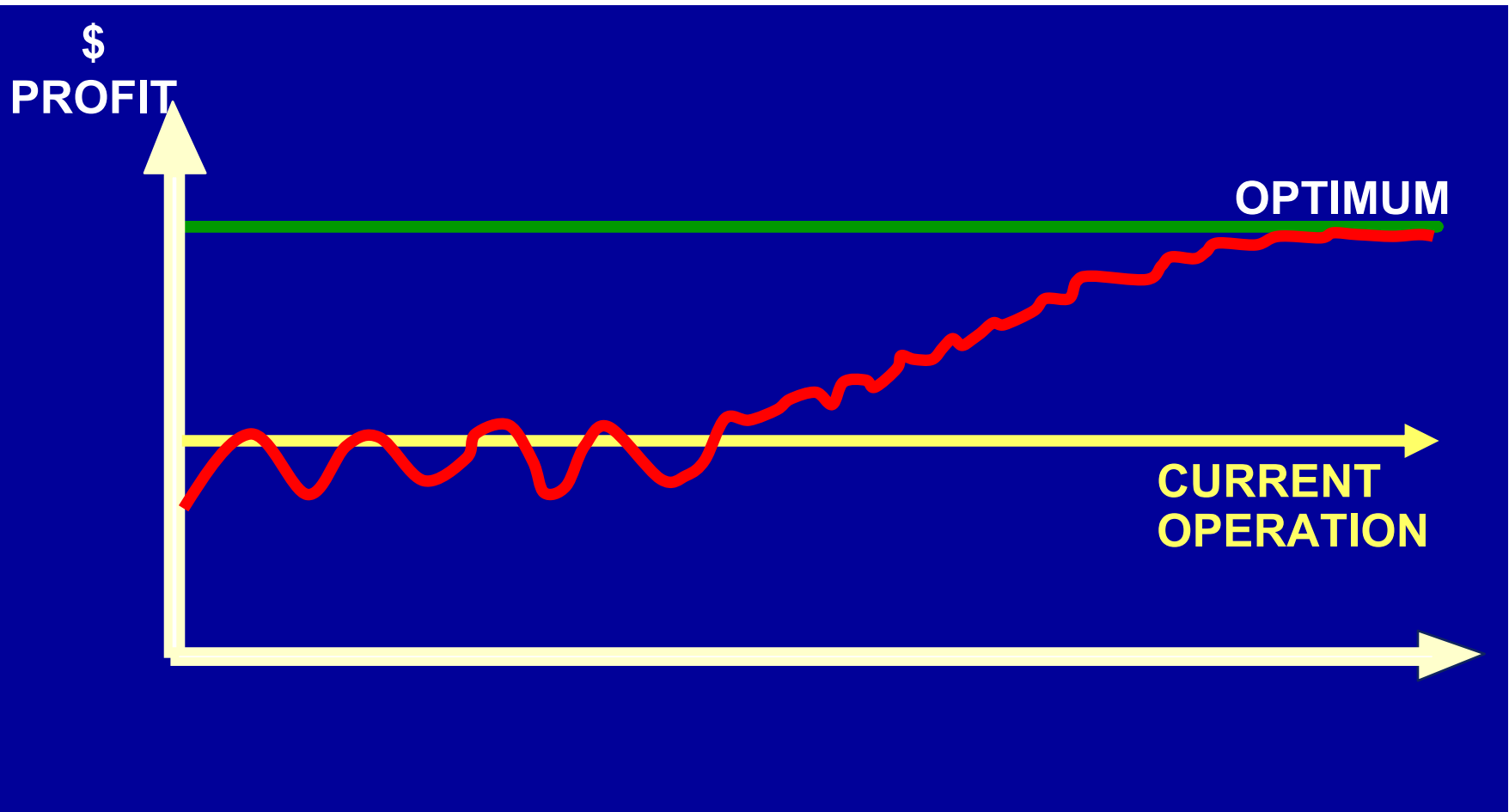
- Improves performance by adjusting a series of process variables in order to increase profitability and minimize operating costs.
- Provides model-based optimization solution
- RTO+ provides a complete optimization solution
 - Complements existing APC (Advanced Process Control) systems
 - Utilizes first-principle engineering models
 - Can be integrated with existing models e.g. HYSYS

RTO+ - Real Time Optimization



The idea is to maximize profit, while remaining within the limits and constraints of the system.

Improve Profits with RTO+



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Online Optimizer Components

- DXS - Data eXchange Server
 - Used to connect DCS data to RTO+ system
 - Performs data conditioning/data validation
- Executive
 - Schedules online process execution at specified frequency (i.e. every 20 minutes, hourly, daily, etc)
- RTO+
 - Interface for model configuration
 - Calculation engine for model, parameter estimation and optimizer processes

Online Optimizer Processes

- Typically there are three different kinds of process running in the online system:
- Model process
- Parameter Estimation process
- Optimizer Process
 - Setpoint Optimizer
 - Selection Optimizer

RTO+ Online – Model

→ Model Process:

- Evaluates plant at current conditions with validated process data from DCS via DXS and current parameter values
- Used for Key Performance Indicator (KPI) result generation (i.e. GT heat rate, ST stage efficiency)
- Also generates current constraint values for limit updating
- Should accurately match current operation of the plant (within 1-2 %)

RTO+ Online – Parameter Estimation

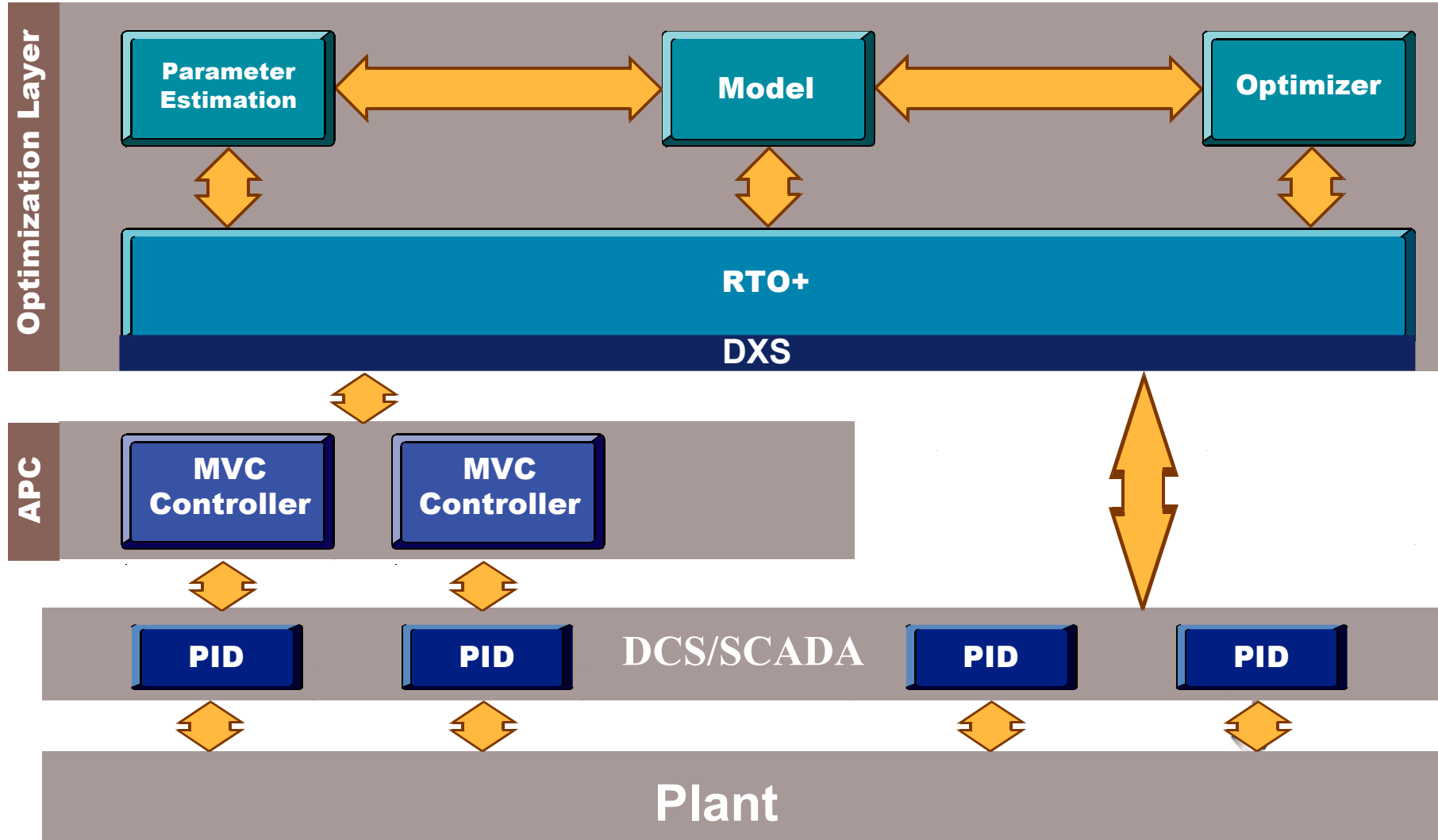
→ Parameter Estimation Process

- Updates equipment parameters (e.g. ST stage efficiency) based on multiple validated input and output datasets
- Example: Steam Turbine 1st Stage Efficiency
 - Inputs: HP Steam Conditions, Stage Exit Pressure
 - Outputs: Stage Exit Temp, Stage Power Output
 - Parameter: Stage Efficiency
- Varies parameter to match output data for the input data. Finds best parameter value to match all datasets

RTO+ Online – Optimization

- Optimizer Process
- Objective: Minimize cost by finding best value of process handles, without exceeding operating limits of plant
 - Uses plant model at current condition as start point
 - Variables: Process handles operators use to manipulate equipment rates (i.e. ST Admit Steam Flow)
 - Constraints: Equipment or process limitations (e.g. Minimum Condenser Flow)
 - Objective function: Total plant operating cost (\$/time). Minimized by RTO+ optimizer

Control and Optimization Architecture



RTO+ Summary

- RTO+ provides comprehensive plant modelling, data reconciliation, instrument error detection, performance monitoring, auto tuning and selection optimization capabilities.
- RTO+ is unique in its ability to solve extremely complex and large optimization problems in real-time.
- RTO+ operates closed loop, offering more flexibility and versatility to the end user to solve tough real world problems.
- RTO+ typical scope of applications are unit, site and business-wide economic optimizations.

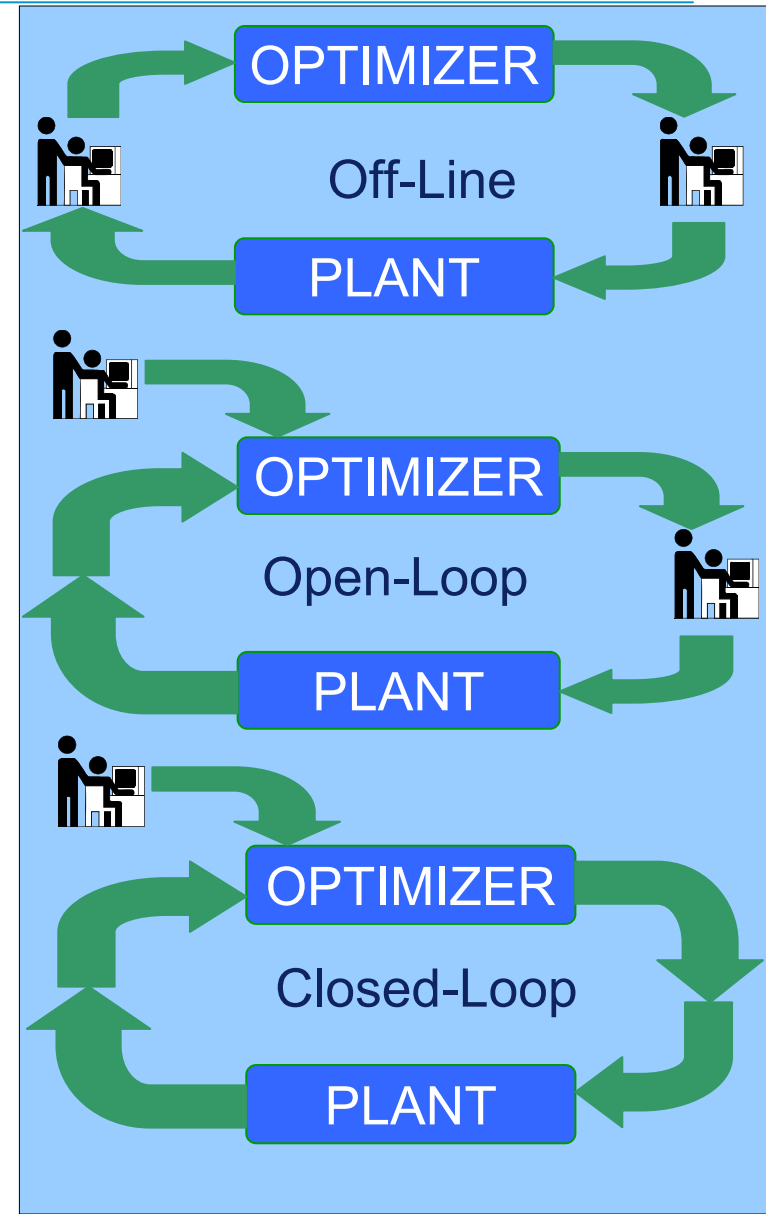
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RTO+ - Project Lifecycle

- Project Initiation & Justification
- Project Implementation
 - Offline Model Build
 - Offline Optimizer
 - Online Open-Loop Optimizer
 - Online Closed-Loop Optimizer

Benefits evaluated before moving to the next stage of the project



Project Benefits Analysis

- Site visit conducted by MDC Consultant
 - Discuss plant operation with Process Experts
 - Identify opportunities for optimization based on current operating constraints
 - Collect process and cost data to identify potential benefits of implementing optimization
- Present report to Client with suggested project type (open-loop, closed-loop, etc) and cost benefits potential
 - Becomes basis for project scope

Project Execution

- Two main steps in project build phase
- Offline System Configuration
- Online System Implementation

Project Execution(2)

→ Offline System Configuration

- Write requirements specification to detail model scope
Agree with Client that specifications meet requirements
- Build plant model. Add parameter estimation and optimizer functionality
- Conduct model reviews with Client to validate plant model configuration against actual process
- Test model and optimizer behavior with “live snapshot” data sets
- Perform Factory Acceptance Test (FAT) to prove functional requirements have been met

Project Execution(3)

- Online Site Installation/Commissioning
 - Connect plant data to online processes
 - Verify data connectivity
 - Perform data validation where necessary
 - Start online parameter updating and model processes
 - Validate model results: compare to plant data
 - Start optimizer process for set-point generation
 - Verify optimizer results with Process Experts
 - Perform Site Acceptance Test (SAT)
Begin Warranty phase

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Energy Optimization Example - Dow Freeport Chemical

→ Project: Consulting and MDC optimization software to address

- 4 cogen plants with 12 Gas Turbines, 7 Steam Turbines & 2 Fired Boilers producing over 1200 MW of power
- Major issue was rapid price changes



→ Result:

- Optimally respond to energy price and demand changes
- Predict cost of operating degraded equipment
- Online Selection Optimizer to identify optimal equipment slate

Complexity

- 60 process variables
- Over 300 constraints
- Interlocking and overlapping constraints (esp. combined steam headers)
- Full electrical distribution model included
- Explicit limits (e.g. GT/ST power)
- Implicit limits (e.g. GT TIT)

The Optimization Solution

- RTO+ Based On-line, open loop, optimization system
- Optimization System
 - Predicts best values for selected variables
- On-line
 - takes process readings directly from DCS
- Open Loop
 - produces recommendations rather than influencing plant directly

Online Optimizer Components

- Data validation
- Model updating/Parameter Estimation
- Base case simulation
- Setpoint optimizer
- Selection optimizer

Degrees of Freedom

- GT Fuel Flow, IGV position and Steam Injection Flow
- ST Admission Steam and Extraction Steam Flows
- FB Fuel Flow
- De-superheater Flows
- Steam Header Vent Flows

Optimizer : Power & Utilities Constraints(1)

→ For each Gas Turbine

- Power Generation
- Exhaust Temperature
- HRSG Steam Temperatures
- NOx Flow

→ For each Steam Turbine

- Admission Temperature
- Power Generation
- Stage Flows and Stage Exit Temperatures

Optimizer : Power & Utilities Constraints(2)

→ For each Fired Boiler

- Fuel Volume Flow
- NOx Flow
- Energy Input
- Burner Pressure

Optimizer : Power & Utilities Constraints(3)

→ Overall Constraints

- NOx (Upper limit only)
- Plant Power Generation (Upper Limit Only)
- Plant Steam Production (Equality limit)
- Electrical Tie-line MVA (Upper limit only)
- Site Condensate Flow (Lower Limit only)
- Site Power Import/Export

Optimizer Inputs

- Allowable ranges for controlled values (variables)
- Allowable ranges for other plant values (constraints)
- Price data for fuel and electricity
- Process data
-about 3500 inputs in total

Optimizer Outputs

- Optimal equipment selection/values for controlled variables
- Benefit of new setpoints
- Indication of limits on the solution
- Updated performance parameters

Modes of Use

- Global optimization runs (every 20mins)
 - Optimal equipment loading
 - Results displayed on Control Room screens
- Selection optimization runs (every 3hours)
 - Optimal equipment line-up
- What-if runs
 - Perform economic analyses of differing operating scenarios

Aspen Process Explorer - [Optimization Results Home Page.atgraphic]

File Edit View Favorites Tools Window Help

Optimization Results Home Page

Problem Log

Training Clips

Base / Global / Step

Site Overview

Cond. Overview

Breakdown of optimizer savings if current solution implemented

Access results for each model/optimizer process on plant-by-plant basis

The overview screen provides access to all of the optimizer results

View results on per-equipment basis

View key performance results on summary screens

Save last set of results for offline analysis

GT33

GT37

ST32

ST33

Steam

Pwr6

GT61

GT62

GT63

GT66

GT67

ST64

ST65

Steam

Pwr8

GT81

GT82

GT83

ST84 & Steam

FB 44/45

Steam

Electrical

Wet Compression

Optimizer status and performance data

View Status

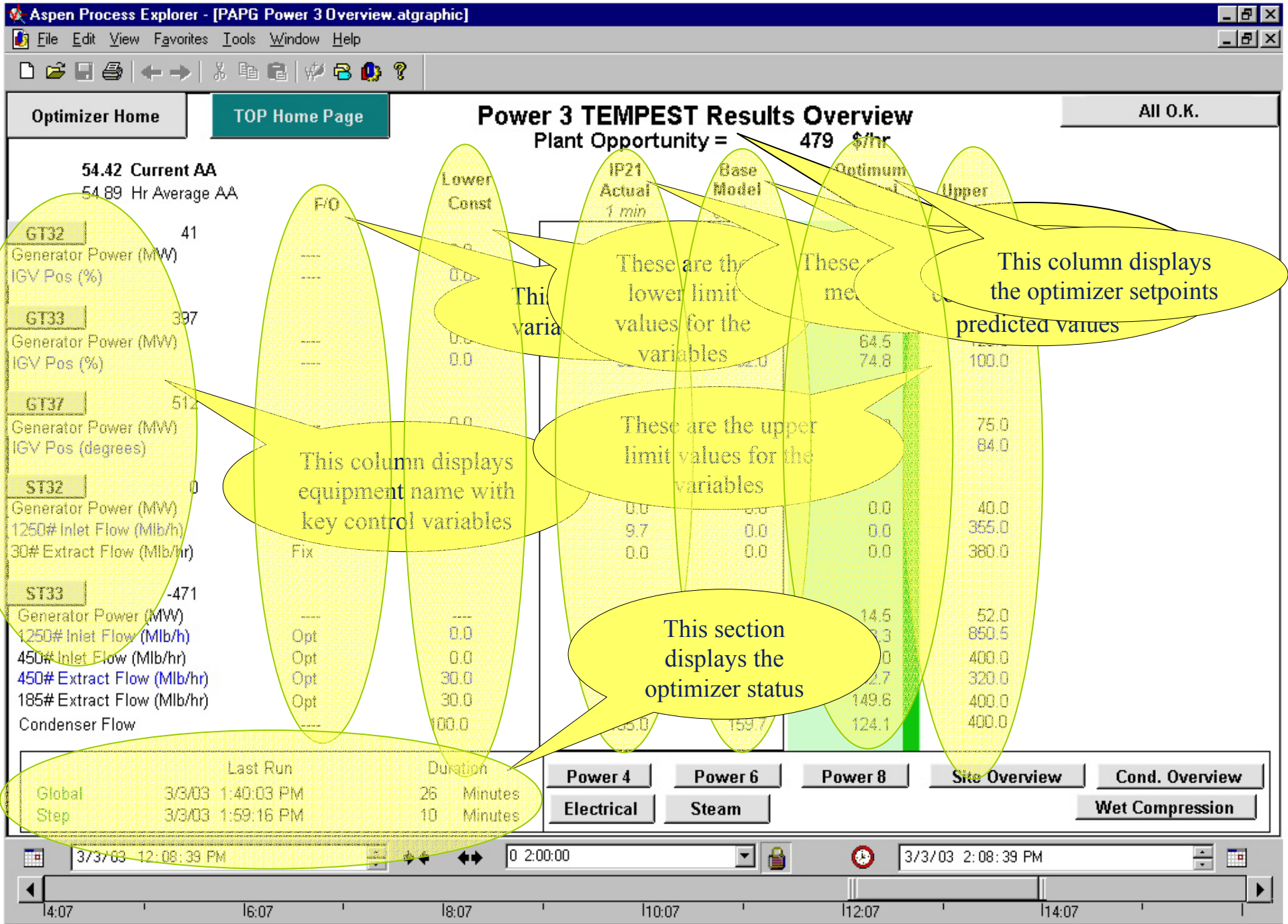
TOP Home Page

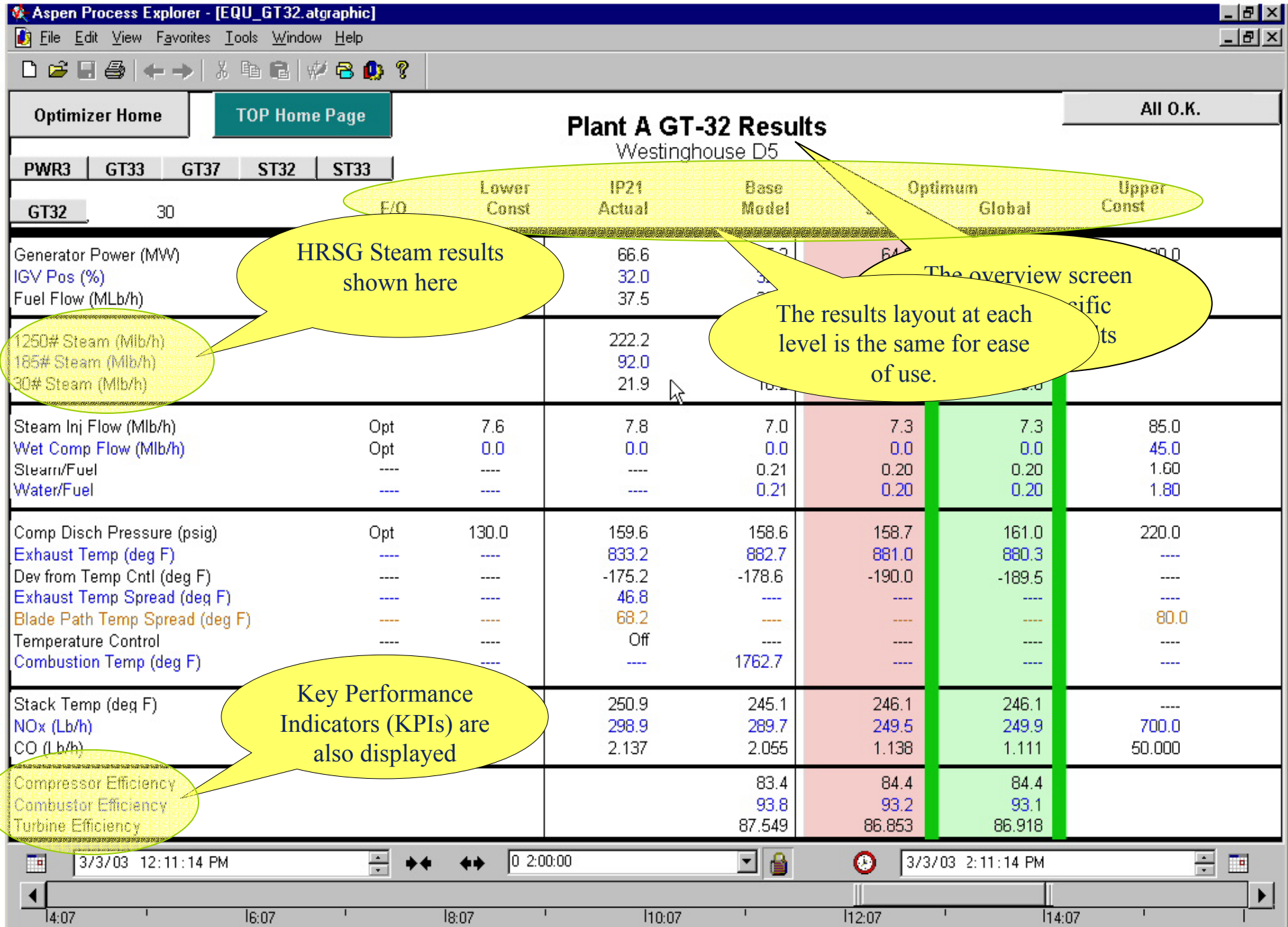
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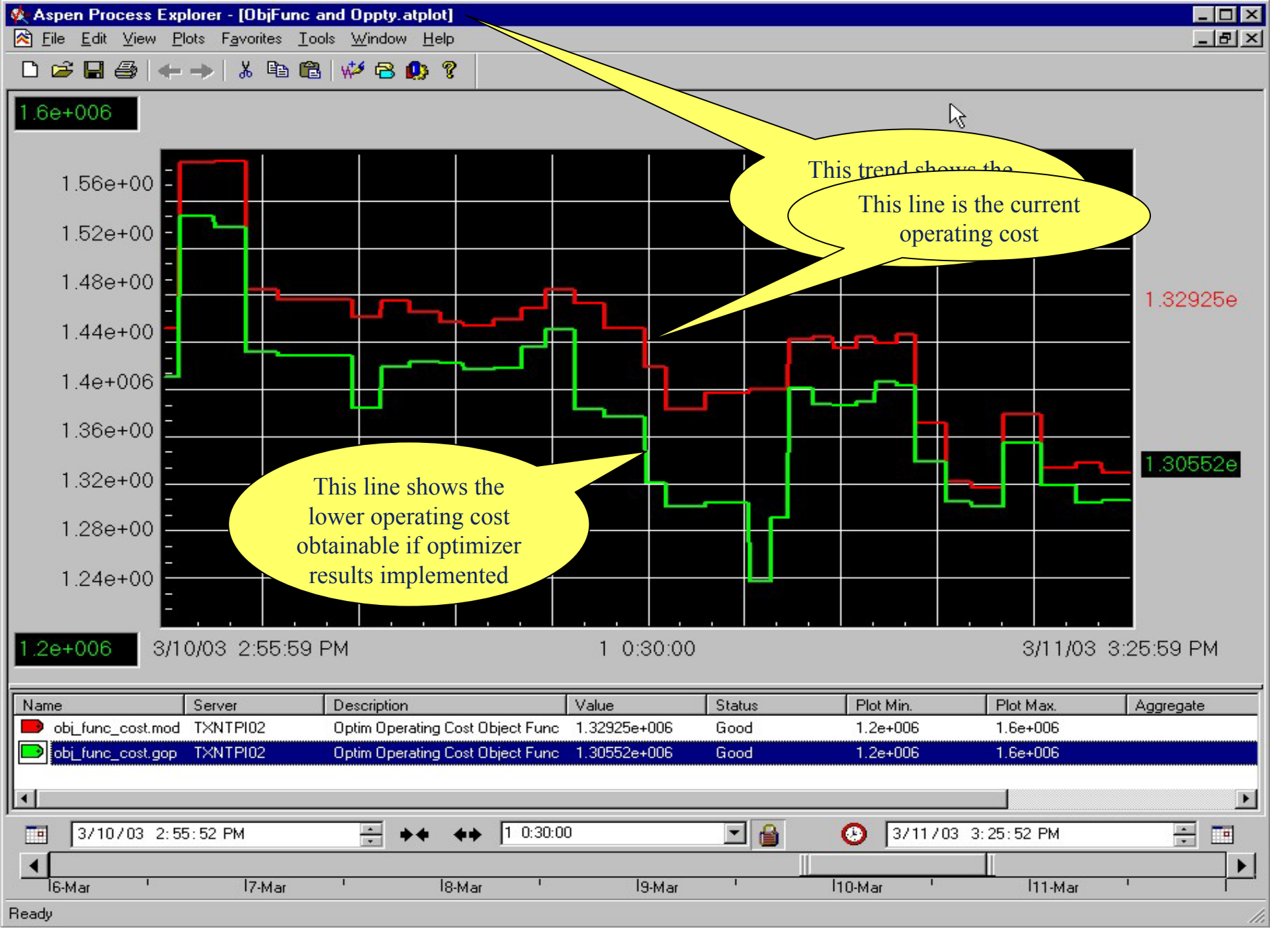
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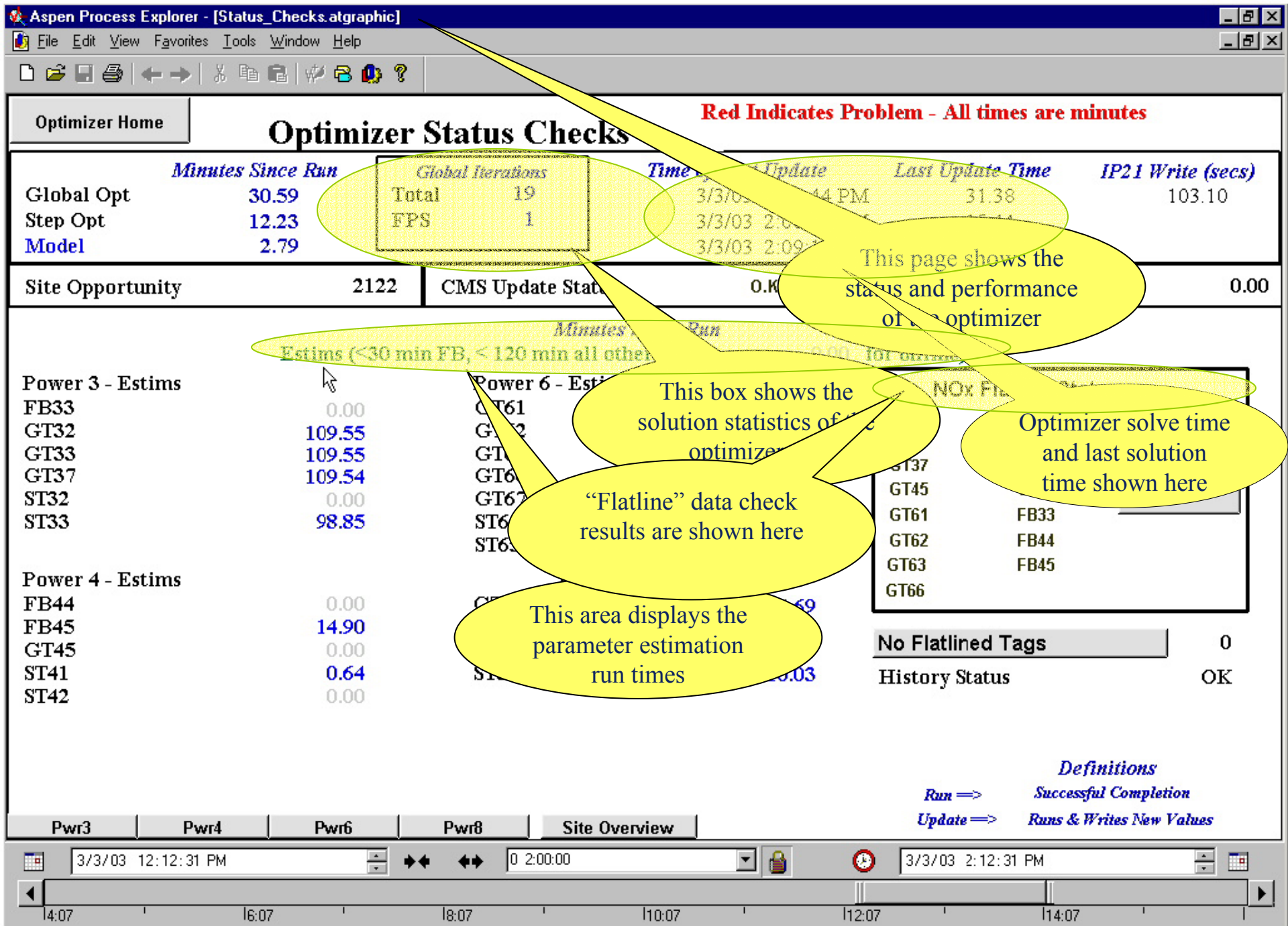
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A photograph of an industrial facility, likely a refinery or chemical plant, at night. The facility is illuminated with various lights, and its structures are reflected in a body of water in the foreground. The sky is dark blue.

***World Leaders in
Real-Time Process Optimization &
Performance Monitoring Systems***

Thank you for your attention

Any Questions???.....